Reverse Engineering Dinosaurs

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The aim of this research is to use traditional CAE/CAD techniques and X-ray imaging to create micro-structurally faithful models of fossilized bones. These are used to test hypotheses about the biomechanics of dinosaurs, enabling palaeontologists to relate form to function in a scientifically robust way.

Introduction

This poster presents the workflow followed in creating a finite element model of a biological structure. A velociraptor claw is used as an example. Was the claw used for killing prey or as a crampon for climbing? How thick was the keratin sheath? A mystery as only bone is preserved!

Techniques

X-ray tomography is used to digitize the external geometry and internal micro-structure of the fossilized claw. CAE/CAD software from Simpleware Ltd. is used to convert the digital images into finite element models that are used to test a range of hypothetical loading scenarios. Material properties are obtained from laboratory tests on extant (living) species.

Results

Preliminary analyses, using the UK National HPC Facility HECToR, show that the claw could support the full body weight of the velociraptor when climbing.

Conclusions

Reverse engineering has the potential to give palaeontologists new insight into the biomechanics of extinct species.

Acknowledgements

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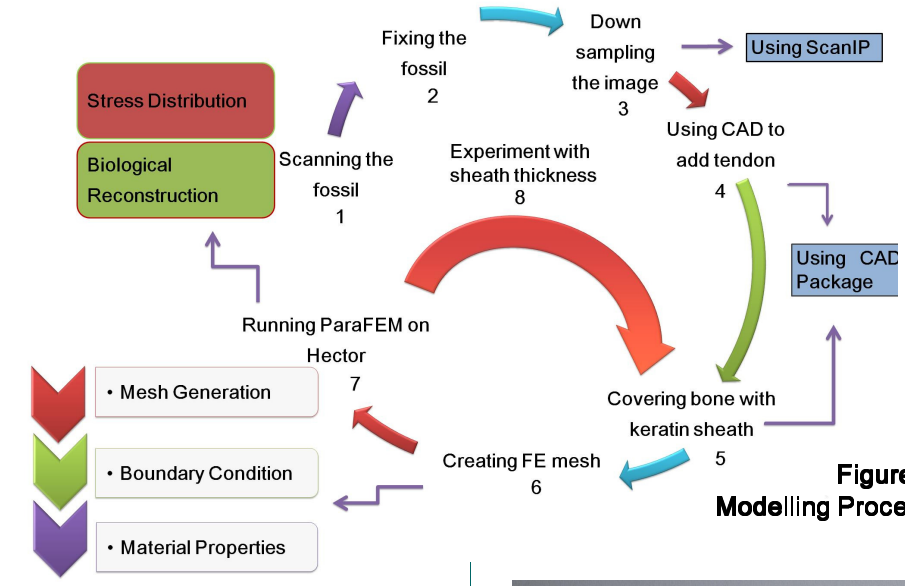

Figure 1 Modelling Process

Figure 2: Artist's View of Velociraptor

Figure 3: Fossil Claw. Scale: cm/mm.

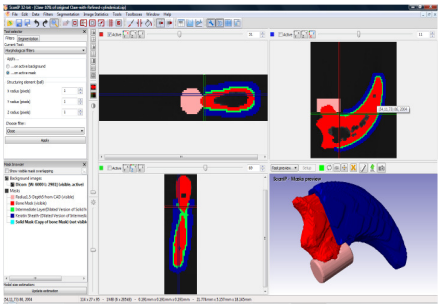

Figure 4: Image based meshing

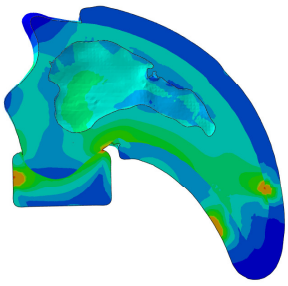

Figure 5: Mises stress map

The Ultimate Goals:

1: Construct biologically realistic models of extinct species for physics-based modeling and simulation.

2: Quantify the physical quantities of interest, such as stress or strain, under different loading scenarios.

3: Understand how form relates to function in biological structures.

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